BRAIN INJURIES, MECHANICS, PROGNOSIS, AND TREATMENT *

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The bones in the human skull are so arranged that the shock of an ordinary injury is well absorbed before the force can be transmitted to the brain. The frontal, mid-parietal and occipital regions bear the brunt of ordinary sublethal injuries. Here the bones are constructed to stand up under greater strain than other contiguous areas, and the portions of the brain that lie in contact with the skull opposite to these areas are less highly organized. The skull, as has often been described, has six perpendicular reinforcements, one corresponding to the mid-frontal region, one corresponding to each external angular process, one corresponding to each of the mastoid regions and one corresponding to the mid-occipital region.

Fractures of the vault are usually directed to the base by one of the thinner portions of the skull, bridging between these reinforced areas. The greatest distance and the thinnest portion of the skull bridges between the external angular process and the mastoid on either side. Thus, more fractures will be directed to the middle fossa. The reason that the posterior fossa has such a large percentage of fractures, some statistics giving a greater percentage of fractures for the posterior fossa, is that great force is often transmitted to the condyles of the occipital bones through the vertebral column. Often short linear fractures are found on either side of the foramin magnum of the occipital bone, but, as a rule, fractures of the posterior fossa communicate with fractures of the middle fossa.

Traumae producing brain injuries may be divided into two types. First type, the injuring object is moving and strikes the head, which is more or less stationary; for example, falling bricks, falling lumber, falling telegraph poles. In this type the injury to the brain is direct and corresponds to the cortex of the brain in immediate contact with the portion of the skull struck. The amount of direct injury being in direct proportion to the amount of force. In the second type, the head is moving and strikes some stationary, or nearly stationary, object. The best example of this type is the person struck by an automobile, the head is slammed against the pavement or curbstone; or the man that is thrown from an automobile, striking head against a tree, a fence-post, or the pavement. In this type there is a certain amount of direct injury to the brain corresponding to the area of impact, but far greater cortical destruction takes place on the opposite side of the brain. This is the contre-coup injury we hear so frequently spoken of. In this type the physical signs usually point to the contre-coup injury as the more extensive. In this type there are always some changes produced in the brain tissue, between the direct injury and the contre-coup injury. These changes varying from a slight agitation of the parenchyma of the brain followed by slight edema, to comminution with multiple hemorrhages and complete destruction. These two types of injuries may be combined; for instance, a man may have a direct injury knocking him unconscious, then he falls to the sidewalk, striking head and producing another fracture with direct and contre-coup brain injuries.

All of the above-described brain injuries may take place without any fracture of the skull. The absence of fracture does not change the prognosis or treatment. Brain injuries with and without fracture of skull are treated the same. Those injuries without fracture are just as serious, and often more so, than those accompanied by fracture. The usual picture at autopsy in these cases without fracture is a wet brain, convolutions flattened, with varying degrees of direct and contre-coup destruction and hemorrhage. Coronal sections show the brain to be studded with petechial hemorrhages, and the cut surface looks pale and waterlogged.

Seven hundred and fifty-five cases of brain injury, diagnosed as fracture of the skull, have entered the San Francisco Emergency Hospital during the last two years and a half.

Thirty-eight and five-tenths per cent resulted from persons being struck by automobiles; 24.2 per cent from falls from buildings, scaffoldings, and swings; 9.9 per cent from persons being struck by street-cars; 9.6 per cent from collisions between automobiles; 3.9 per cent from being struck by falling bricks; 3.4 per cent from fights; 2.85 per cent from street-car accidents; 2.85 per cent from motorcycle accidents; 2.85 per cent from causes unknown; 1.07 per cent from holdups; .7 per cent from automobile street-car accidents.

Since the type of brain injuries received depends upon the character of trauma, the history is very helpful as a guide in the prognosis. It is one of the important means we at times have in differentiating post-epileptic stupors, morphine poisonings, with old or recent scalp injuries, from fractured skulls with brain injuries.

A prognosis depending upon observations made while the patient is in primary shock is very apt to be unreliable. It is also very difficult to prognose upon the findings of one examination. The course of the pulse, temperature, blood pressure, spinal fluid pressure, the rapidity of the changes and disappearance of reflexes, the appearance of pathological reflexes, are of the utmost value in making a prognosis and outlining treatment.

Aids to Prognosis—Head injuries in the old are very serious. The sutures are very rigid and the blood vessels are of such a character that any concussion of the brain results in edema. Infants and children ofter recover from very extensive fractures of the skull with phenomenal rapidity. Hemorrhage from the ears and the nose is not an unfavorable sign. Such cases get along better than those of apparent equal severity without hemorrhages from ears or nose. A return of coma eight to fourteen days following such injuries, abscess of the brain is often the etiological factor. If the pulse does not come down following the usual treatment for shock, the prognosis is grave.

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In all cases where the pulse and temperature begin to climb very soon after the accident, a favorable outcome is rare. Dilated pupils that do not react to light after time has been allowed for subsidence of shock are a very unfavorable sign. Cases that show early signs of cerebral compression usually go on to an early death.

The blood pressure must remain higher than the intercranial pressure; thus, if the blood pressure drops below the intercranial pressure death is imminent. This crisis is manifest by rapid pulse and falling blood pressure, or, as Steward of St. Louis puts it, "When the rate of pulse exceeds the systolic blood pressure registered in millimeters of mercury." This crisis usually takes place several times during the development of cerebral compression. If the regulatory centers of the blood vascular system are not affected, the period of lowered blood pressure will be very short, but as the intercranial pressure becomes excessive, there comes a time when a greater rise in blood pressure is impossible. Rapid pulse, Cheyne Stokes respiration, are the result of this final crisis. The character of the scalp injury is of very little value as a guide to the severity of the brain involvement.

The most valuable localizing sign as to the side of the compression and the degree of compression, in my experience, has been the condition of the pupils. The pupil on the side of the beginning compression at first reacts very sluggishly, often showing a hippus. As the compression increases this pupil slowly contracts, reacting at first, later pin-point and fixed, finally dilating slowly, followed by the same course of events in the other pupil.

The primary treatment in all cases of brain injuries is complete rest in a quiet, dark room, with head and shoulders slightly elevated, ice-cap to head, heat to extremities. Following the subsidence of primary shock, a careful examination must be made and full notes taken. Radiographs are valuable, but a shocked patient must not be moved just for a radiograph. Following the primary examination, the case must be observed frequently and notes made upon the character and rate of the pulse and respiration, character of the mentality, degree of stupor, the presence or absence of convulsions, the movements of extremities, the blood pressure, reflexes, and, in doubtful cases, the cerebral spinal fluid pressure. For the relief of headaches and slight degrees of intercranial pressure, the removal of cerebral spinal fluid is sufficient. The administration of salol coated, sodium chloride pills for the relief of these pains has been efficacious in some cases (W. Hughson, December 10, 1921, J. A. M. A.).

When Should We Operate?—1. Operation is indicated in depressed fractures, after shock has subsided. (2) Any case of increasing cerebral compression, regardless of whether it is due to extradural hemorrhage, intradural hemorrhage or parenchymatous edema, if the same is not controlled by cerebral spinal puncture and the administration of hypertonic solutions by rectum or sodium chloride pills by mouth. The greatest number of cases that could be helped by surgery, that are overlooked, are very slow-forming extradural hemorrhages that begin to manifest themselves at the end of the second or third day. About 10 per cent of all fractures have sufficient extradural hemorrhage to cause death, and over 50 per cent of this 10 per cent go undiagnosed because of the lack of frequent observation and inattention on the part of somebody.

Operation is not indicated—(1) in brain injuries so extensive that all reflexes superficial and deep are suspended. (2) When the pulse is above a hundred, if the rapid rate is due to shock alone, given time it will slow down and then operation may be performed if indicated; if due to destruction of brain or rapidly increasing intracranial pressure, the pulse continues to go up and any operative interference would only hasten the end. (3) When all the signs of cerebral compression develop very rapidly; for example, in the first hour. (4) Medulary edema manifesting itself very soon after entrance into the hospital by rapid pulse, shallow respiration, and a rapidly rising temperature.

(Butler Building.)

Lay Medicine—Every faith, cult, system of thought, institution of learning or systematized organization wanes in the success of its activities and undergoes retrograde changes unless protected from those influences which make for lessened efficiency and intrinsic worth. Organized religion finds it necessary to adopt measures varying with the needs of the time to preserve the purity of its doctrines and prevent their overthrow or obliteration by the inroads of heresy and schism. The dominant thoughts of national character and politics, unless kept fresh by frequent review and the recollection of salient factors, and lessons learned by history soon change and are perverted into the means of anarchy with resulting harm to peoples and the lowering of the social level of posterity. So also does the torch of true learning become uncertain in its light as a guiding beacon, its bright, clear flame, smoky and dim, will no longer be accepted by peoples as their star of hope in matters medical and hygienic, if it is no longer fed with the fuel of sound, sensible and sane thought and the hand that holds it strong, firm and unshaking.

The torch of scientific medicine, thanks to the combined efforts of many, if not all branches of science, has risen from a murky fog of secrecy, doubt, nostrums and uncertainty and made clear the way for the solution of medical problems which with ever increasing knowledge have multiplied many fold until our information on many medical subjects is quite complete and satisfying. Until within a very few years it has seemed that the medical profession was not only the custodian of knowledge of matters medical but also the means of putting into practice the means of prevention and cure of disease. It was furthermore closely associated with allied subjects, all of which insured its position as a competent adviser of individuals and peoples, and made it as great as any of the learned professions. That a change in its status, a curtailing of its fuctions and a lessening of its usefulness as a leader of sound, scientific thought has taken place is evident to anyone.—Editorial, Rhode Island Medical Journal, April, 1923.